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DEVELOPMENT OF THE AGRICULTURAL SECTOR IN HAWAII

Shelley M. Mark and Robert L. Lucas

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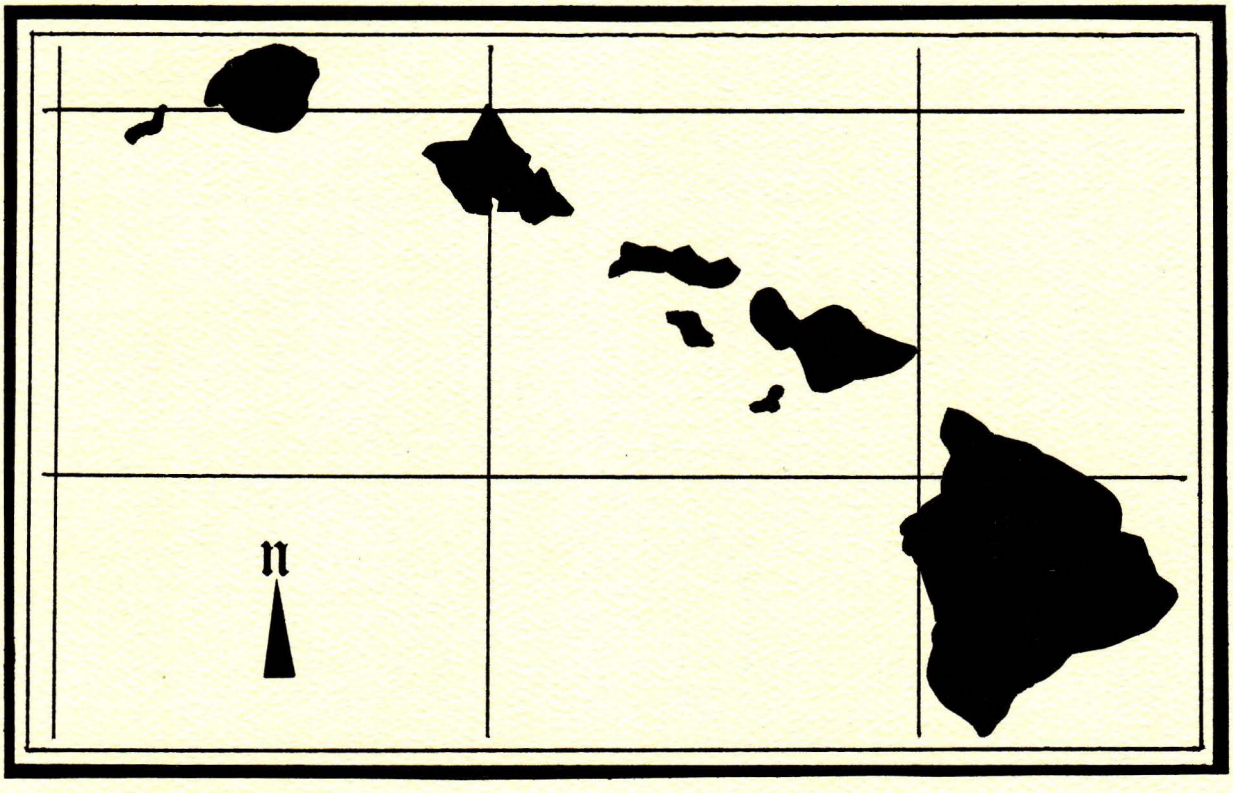

Hawaii Institute of Tropical Agriculture and Human Resources
UNIVERSITY OF HAWAII

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THE AUTHORS

Shelley M. Mark is Professor, Department of Agricultural and Resource Economics, University of Hawaii.

Robert L. Lucas is Research Associate, College of Tropical Agriculture and Human Resources, University of Hawaii.

PREFACE

This report is a brief review of the development of the agriculture sector in Hawaii. Since existing reports and studies document the structure and performance of Hawaiian agriculture and its relationship to other parts of the economy, no attempt has been made to present a comprehensive social and economic profile, as was done for the other Pacific islands. The review here covers the economic significance of agriculture in Hawaii, its potential, and the current development issues that must be resolved. It is drawn from the final report prepared under U.S.D.A. research agreement No. 58-9AHZ-9-474 for the Section 406 program, Food for Peace Act of 1966, entitled: Socio-Economic Criteria for Scientific Research to Improve Tropical Food Production Systems (with Particular Reference to American-affiliated Pacific Islands), March 1982. The cooperation of the Science and Education Administration of the U.S. Department of Agriculture is hereby acknowledged.

In many respects, Hawaii possesses one of the most advanced tropical agriculture sectors in the world. Still, a host of serious problems constrain production and obstruct the accomplishment of important state objectives. Both historically and at the present time, social and economic circumstances exert a major influence on what can be accomplished in agriculture. This is as true of Hawaii as of the American-affiliated Pacific islands. To accelerate agricultural development and to achieve societal goals set for this sector, it is critically important that socioeconomic, as well as biological and technical, factors be considered in designing programs and projects. This was the principal theme of the parent project from which this publication is derived.

The authors wish to express their appreciation to Professor Emeritus Perry Philipp, author of Diversified Agriculture of Hawaii, who kindly loaned us some additional unpublished materials which updated his earlier work, and to Dr. Bruce Plasch, who made available information from his recently completed sugar study for the State of Hawaii. Other acknowledgments are contained in the U.S.D.A. project report.

Abstract

This report reviews early development and recent trends in Hawaiian agriculture, examines potentials for various commodities, and analyzes constraints and broader issues affecting Hawaii's agricultural future. Hawaii's economy has traditionally been based on two plantation outputs, sugar and pineapple, Recently, international developments and removal of national protective legislation have weakened the contribution of these sectors. Economic growth has been sustained by tourism, Federal defense expenditures, and various miscellaneous activities. Yet official State policy calls for maintenance of agricultural viability. Its feasibility will depend on how broader constraints in land and water use, environmental pressures, credit, transportation, labor supply, and government support are dealt with.

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A. Economic Significance

1. Early Importance of Agriculture

In the prediscovery period the Hawaiian people practiced an intensive form of agriculture. The cultivation of taro, from which poi is made, was the principal staple of the populace, with breadfruit, bananas, plantain, sugarcane, cava root, and sweet potatoes also being grown. The main source of protein was fish, while small hogs, chickens, and dogs constituted the only livestock raised for food. The success of the Hawaiians in practicing agriculture may be judged by the fact that the population was estimated to be 300,000 at the time of first western contact by Captain Cook in 1778. By 1850, the Hawaiian population had declined to about 82,000 and non-Hawaiians numbered about 1,500 (Morgan, 1948). The intrusion of foreign culture, with the attendant disruption of native productivity, nutritional and health standards, is generally believed to have caused the drastic decline in population.

The first foreign stimulus to agriculture came with the demand for provisions by ships stopping in the islands. During the first few decades after discovery, the ships were primarily those engaged in the sandalwood and fur trade between the Pacific Northwest, Hawaii and China. Whaling ships began using Hawaii as a base of operations and during the 1840-1860 period, this activity was a major source of foreign demand for agricultural commodities. From 1848 to 1851, the California gold rush brought about a boom in the demand for Irish and sweet potatoes and other crop and livestock commodities. Throughout the first five decades of the nineteenth century, most crops were grown by the native Hawaiians on "kuleanas"--the functional unit of land farmed by the commoner on a tenancy basis. Upland kuleanas were usually from 7 to 9 acres, while those in the fertile bottom lands were smaller.

Before 1844, the lack of markets, the land tenure system, and inertia on the part of the resident foreigners were the main factors inhibiting agricultural development. During the period 1845-1850, a basic change in the land-holding system was made. Under the feudal system, all land belonged to the king who distributed it among his chiefs; the commoners farmed their kuleanas as tenants of the chiefs, retaining only about one-third of the production.

Under pressure from both resident foreigners and the native commoners, the king dropped the feudal system in favor of an allodial system of fee simple ownership by individuals. This land reform is considered a land mark in Hawaiian history and an indispensable prerequisite for the later rise of the sugar industry (Morgan, 1948).

Settlement of the west coast of the U.S., land reform and the decline of whaling after 1860 were important factors contributing to a much greater interest in agriculture, especially on the part of the resident foreigners. With export markets for agricultural products developing on the west coast, a variety of crops were attempted. Although cattle ranching, coffee, and rice enjoyed some success, it was sugar that became the dominant agricultural industry in Hawaii.

Sugarcane was already growing in Hawaii when Cook made first contact. It apparently had been brought to the islands by the Polynesians in their early migrations. As early as 1802, sugar was produced on a small scale by a visiting Chinese on Lanai. The first successful commercial venture was established in Koloa, Kauai in 1835. Processing methods were primitive and the quality of sugar was very poor up to about 1842.

The early years of sugar were very difficult. Although the settlement of California created a large demand and increased prices for sugar, the gold rush drew away Hawaiian labor as many of the natives emigrated to the gold.fields. A drought in 1851, and a drop in sugar prices in the California market in 1851-52 caused additional hardship, and by 1857 the number of plantations had dropped to five from the eleven that were reported in 1846 (Morgan, 1948).

After 1857, the sugar industry grew rapidly under the positive influence of technical improvements and favorable prices, especially during the Civil War period when the North was cut off from the supply of Louisiana sugar. During the Civil War, sugar exports from Hawaii increased from 572 to 8,865 tons. There were 20 plantations in 1875 producing about 12,500 tons of sugar. Also in 1875, a Treaty of Reciprocity between the U.S. and Hawaii was concluded, providing for the free entry of Hawaiian sugar and molasses into the U.S. In 1880, there were 63 plantations; by 1898 at the time of annexation by the U.S., the output of sugar in Hawaii was 229,400 tons (Philipp, 1953).

Technical progress in both sugar cropping and processing, the introduction of large scale irrigation, and the favorable market conditions associated with the Civil War and the Treaty of Reciprocity stimulated growth in the industry, and in turn, created an acute demand for labor and heavily influenced the nature

of the emerging plantation system.

Obtaining adequate labor for sugar production and processing was a problem from the beginning. As early as 1838, dissatisfaction was expressed over the use of native Hawaiian workers. Besides the qualitative deficiencies expressed by the industry, there was also the problem of increasing labor scarcity, due to the decline of the native population, aggravated by the loss of workers who joined the whaling ships or emigrated to California during the gold rush.

Finally, the decision was made to import foreign labor and 280 Chinese were brought to Hawaii in 1852 to work on the sugar plantations, each to work five years at $3 a month, plus room, board and clothing. Until 1865, the number of foreign workers imported was fairly modest, numbering 1,306. In 1868, 148 Japanese were imported, with much larger numbers of Chinese, Japanese, Portuguese, and other immigrants being brought in after 1875 (Morgan, 1948).

The plantation system that evolved in the sugar industry was the result of a number of unique circumstances. First, the efficient size of the productive unit was large. Given the large scale, it was convenient to have the workers live on the plantation. In the early years, there was a paternalistic concern for the Hawaiians, partly motivated by the desire to separate them from their ties to the chiefs. The subsequent immigration of foreign workers who could not speak the local language and whose contracts specified room and board, reinforced the utility of keeping workers on the plantation. As this custom developed, the plantation company came to supply practically all of the workers' needs, including medical, store goods, entertainment and later even the children's schooling. A plantation social and economic hierarchy replaced the former feudal system of the Hawaiians.

Another facet of the plantation system which also was to have later social and economic ramifications was the use of agents by the plantations. The typical large scale of operations which combined processing and cultivation of the sugar, caring for virtually all the needs of the plantation workforce, and the rapid technological changes taking place, all contributed to the use of agents, or factors, as they were called, to take care of most of the commercial and financial business of the plantations. Many of these firms had gained experience and built their businesses in Honolulu in large part by serving the whalers. As the whaling trade declined sharply after 1859, these merchants had considerable unutilized resources and began to take care of the buying of tools and supplies, selling the sugar, and the overall financial needs of the plantations.

Because of the large capital requirements of the sugar plantations to meet the continuing advance of technology and productivity, the factors became the dominant economic force in the industry and in much of the rest of the economy up to the onset of the second World War. The controlling factors in the mid-twentieth century became known as the "Big Five." These five firms had origins dating back to the 1820s.

In terms of direct and indirect employment created, income, and acreage in cultivation, sugar has continued to dominate the Hawaiian agricultural sector. In 1952, some 28 plantations accounted for about 90 percent of the 1,020,000 tons of sugar processed. The total area planted in sugarcane amounted to 222,000 acres in this same year, with the average per plantation being almost 8,000 acres.

In contrast, pineapple, the second largest agricultural industry in Hawaii, was planted on 73,500 acres in 1952, most of which was cultivated on 14 plantations. The importance of pineapple is indicated by the 1952 statistics on wholesale value: raw sugar, including molasses and government compliance payments, amounted to $139.9 million; canned pineapple fruit and juice, $100.0 million; and all other crops and livestock, $39.2 million. The relatively high value of pineapple is explained by the fact that processing is included in the value figure, whereas the value of sugar includes only the preliminary processing stage, after which the raw sugar is shipped in bulk to the refinery in California (Philipp, 1953).

Agricultural crop and livestock commodities, excluding sugar and pineapple, came to be referred to as diversified agriculture. Crops such as rice, coffee, corn, taro, sweet and Irish potatoes, were all harvested in relatively large quantities at one time. However, their significance has declined in recent years due largely to changing market conditions. In the latter nineteenth and first half of the twentieth century, most diversified agriculture supplied the local markets, particularly the rapidly growing Honolulu area. Fresh vegetable growing steadily increased; in 1952, about 4,700 acres were harvested, which was enough to supply about 35 percent of the total amount marketed in Hawaii. Bananas, avocados and mangos were grown in large quantities for the Hawaii market, and a number of new crops were introduced. Papayas, macadamia nuts, and flowers and other ornamentals were some of the potential export crops getting their commercial start as early as 1920.

In addition to the cattle industry which enjoyed early success, dairying, chicken and egg production, and swine raising gradually developed into signifi-

cant diversified agricultural activities by 1952. Virtually all of Hawaii's livestock production is for resident consumption.

While sugar and pineapple at an early stage came to be farmed primarily by large, corporate-managed plantations, most diversified agriculture production, with the exception of cattle ranching, was in the hands of small, family-oriented producers.

2. Recent Agricultural Development

Up to World War II, the Hawaiian economy was largely agrarian-based. In 1940, about 36 percent of civilian employment (54,629) in Hawaii was in agriculture, forestry and fisheries (State Dept. of Planning & Economic Development, 1972). When directly related sugar, pineapple, other food processing, and supply industry employment are considered, it is clear that this primary sector dominated the economy.

In the post-war period, the defense build up which accelerated dramatically with World War II and continued in support of the Korean War, and the stimulus to the visitor industry resulting from advances in commercial aviation, broadened the economy and lessened the prominence of agriculture. The leading sector in Hawaii in 1960 was federal spending, accounting for about 20 percent of gross business receipts, while agricultural sales, including processing, amounted to about 12 percent (see Table 1). Sugar was still the leading commodity industry within agriculture, representing over 40 percent of total sector sales.

The data in Table 1 indicate that in constant dollar terms the value of total agricultural production grew modestly between 1960 and 1980, increasing from $526 million to $671 million, an average annual rate of 1.2 percent. In comparison, visitor expenditures increased from $235 million in 1960 to $2.034 billion in 1980, an annual rate of almost 11 percent a year. Federal expenditures, diversified manufacturing and construction also grew rapidly during the 1960-1975 period, and these industries along with tourism represented about 50 percent of gross business receipts in 1980. Although still an important economic sector, agriculture more than ever before must compete with other industries for such basic resources as land and water.

The data presented in Tables 2 and 3 indicate the decline in the relative importance of agriculture in terms of personal income and employment. Between 1960 and 1980 there was an increase from $153 million to $168 million in personal income contribution of agriculture (constant dollars), but relative

TABLE 1

Major Economic Activities in Hawaii
(millions of 1975 $)

Activity	1960	1965	1970	1975	1980
Agriculture	526	580	539	607	671
Sugar[1]	(228)	(290)	(269)	(366)	(403)
Pineapple	(214)	(208)	(183)	(142)	(151)
Diversified	(84)	(82)	(87)	(99)	(117)
Construction	494	562	1,064	1,140	1,058p
Diversified Manufacturing	268	461	582	811	1,051
Federal Expenditures	873	1,061	1,452	1,980	2,242
Military	(670)	(754)	(916)	(1,028)	(949)
Civilian	(203)	(307)	(536)	(952)	(1,293)
Visitor Expenditures	235	369	807	1,360	2,034p
GROSS BUSINESS RECEIPTS	4,377	5,307	8,450	10,734	12,841p

p = preliminary

1. Including molasses

Note: Original dollar figures have been adjusted for inflation by using the Honolulu Consumer Price Index for Urban Wage Earners and Clerical Workers.

Source: Gross business receipts - First Hawaiian Bank, Economic Indicators. 1980 data for sugar, pineapple, and diversified agriculture are from State Department of Agriculture; sugar and pineapple figures represent value of processed production. All other data are from Bank of Hawaii, Hawaii 1981.

TABLE 2

Hawaii Personal Income by Industry Source
(in millions of 1975 $)

Industry	1960	1965	1970	1975	1980
Manufacturing	212	230	277	272	279
Construction	203	246	434	427	376
Wholesale Trade	115	144	197	206	222
Retail Trade	221	279	403	494	583
Finance, Insurance & Real Estate	110	162	242	272	389
Transportation, Communications & Utilities	154	200	338	383	479
Services	273	397	623	778	994
Agriculture[1]	153	159	160	173	168
Federal Government					
Military	293	357	393	496	439
Civilian	276	361	460	475	420
State & County Gov't.	187	275	467	527	548
Property Income	325	449	602	784	925
Net Transfer Payments	43	74	164	455	532
TOTAL	2,565	3,333	4,760	5,742	6,354

1. Personal income from agriculture includes income from fishing, forestry and private agricultural business services such as veterinary and other farm services.

Source: First Hawaiian Bank (from reports issued by U.S. Department of Commerce, Bureau of Economic Analysis).

TABLE 3

Employment by Industry[1]

Industry	1960	1965	1970	1975	1980
Sugar	14,650	12,600	10,950	9,650	8,900
Field	(8,250)	(7,000)	(5,900)	(5,200)	(4,850)
Mill	(6,400)	(5,600)	(5,050)	(4,450)	(4,050)
Pineapple	11,150	9,800	8,400	5,100	5,900
Field	(4,150)	(4,050)	(3,600)	(2,300)	(2,500)
Cannery	(7,000)	(5,750)	(4,800)	(2,800)	(3,400)
Diversified Agriculture	1,400	1,500	2,950	3,350	3,250
Diversified Manufacturing	11,250	13,150	15,700	6,400	16,050
Construction	17,600	17,900	25,750	26,350	23,950
Transportation, Communication & Utilities	14,750	16,400	24,050	26,450	30,900
Retail Trade	31,150	37,800	53,250	67,900	85,950
Wholesale Trade	11,550	12,850	16,100	15,850	18,550
Finance, Income & Real Estate	9,250	13,300	18,150	24,250	33,550
Hotels	4,350	6,300	13,400	19,950	24,950
Other Services	25,000	32,550	43,850	56,500	73,950
Federal Government	27,000	29,700	33,400	30,550	30,000
Defense Dept.	(18,650)	(19,050)	(22,100)	(19,700)	(18,750)
Civilian Agencies	(8,350)	(10,650)	(11,300)	(10,850)	(11,250)
State & County Gov't.	22,500	28,150	40,250	51,450	59,050
Self-Employment	26,450	27,750	25,400	26,950	29,400
Agriculture	(5,400)	(4,300)	(4,650)	(4,800)	(4,500)
Non-agriculture	(19,950)	(24,850)	(20,250)	(22,050)	(24,900)
TOTAL JOBS	228,050	259,750	331,600	380,900	440,350

1. Number of jobs as opposed to number of individuals employed. Some persons hold more than than one job, thus number of jobs exceeds number of persons employed. Figures are monthly averages for each year.

Source: First Hawaiian Bank.

to total personal income, the agricultural contribution fell from about 6.0 percent to 2.6 percent over the same period. Reflecting the very large increase in number of visitors coming to Hawaii, the services, retail, and transportation, communications and utilities sectors all grew rapidly between 1960 and 1980.

At the same time, employment steadily declined in sugar and pineapple, although increasing in diversified agriculture (Table 3). To a large extent, productivity increases in sugar offset declining employment, keeping total production almost level between 1970 and 1980 (Table 4). In pineapple, production declined, but not as much as employment. However, given the 29.3 percent reduction in pineapple acreage, it is apparent that productivity increases also were very significant in the industry. Acreage devoted to diversified crops increased from 20,000 to 29,300 acres in the 1970-1980 period. Considering the relatively large (46.5 percent) increase in diversified acreage, compared with the small increase (10.2 percent) in employment for the decade, productivity gains probably occurred among many of the separate industries comprising diversified agriculture. Thus, despite the overall decrease of 3,200 agricultural (excluding processing) jobs between 1960 and 1980, real personal income generated in this sector did increase.

The relative importance and performance of sugar, pineapple and diversified agriculture is indicated in Table 4. With respect to crop acreage, sugar still utilizes 75 percent (1980) of all land used for crops in Hawaii. Pineapple, the next largest user of cropland, is currently grown on an estimated 43,000 acres or almost 15 percent of the land used for crops. Although presently relatively small, the 29,300 acres (10 percent) used for diversified agriculture represents a large increase from the amount used in 1970. The diversified acreage figures in Table 4 do not reflect another 558 acres (1980) in aquaculture ponds (DLNR, personal communication, 1982). This is a relatively new industry in which there is much optimism about future growth. Aquaculture is discussed in the next section on the potential of Hawaii commodity industries.

Between 1970 and 1980 the trend in sugar production was slightly down, declining about 1.0 percent per year on average. As mentioned above, the decline in pineapple production since 1970 has been more rapid, about 3.7 percent per annum on average. With respect to value of production (in current dollars), sugar has fluctuated considerably, reflecting the instability in world sugar prices and the fact that the U.S. Sugar Act, which stabilized domestic sugar

TABLE 4

Sugar, Pineapple and Diversified Agriculture: 1970-1980

Industry	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Sugar:											
Production (000 tons)[1]	1,484	1,559	1,427	1,431	1,334	1,408	1,325	1,318	1,339	1,386	1,338
Acreage (number)[2]	239,000	232,300	229,600	226,600	224,200	221,400	221,600	220,700	220,700	218,800	217,700
Farms (number)	717	612	577	538	527	520	520	520	480	400	330
Value (000 $)[3]	110,600	115,800	117,300	141,900	442,300	237,000	164,700	144,200	182,700	217,600	385,100
Pineapple:											
Production (000 tons)[4]	954	942	947	810	700	720	680	690	675	681	657
Acreage (number)[5]	60,900	60,900	58,100	57,500	55,000	50,000	48,000	45,000	43,000	44,000	43,000
Farms (number)	47	36	36	33	20	20	16	16	16	15	18
Value (000 $)[6]	39,500	40,300	43,900	39,600	40,259	41,616	52,983	62,249	63,090	69,409	76,596
Diversified:											
Acreage in Crops (number)	20,000[7]	20,000[7]	20,000[7]	22,100[7]	24,400	26,700	26,400	27,400	27,700	28,000	29,300
Value of Crops (000 $)	21,919	22,519	24,887	27,886	34,964	40,688	47,815	53,715	62,308	75,779	90,625
Value of Livestock (000 $)	41,648	43,053	46,242	55,267	57,909	58,271	62,322	65,018	72,557	78,464	81,249

1. Raw sugar (96°) and molasses.
2. Acreage in crop.
3. Farm value of cane for sugar.
4. Fresh weight.
5. Land used for pineapple.
6. Farm value of fresh weight.
7. Excludes seed corn and feed crops.

Source: Statistics of Hawaiian Agriculture, 1972, 1977, 1980 issues.

TABLE 5

Sugar, Pineapple and Diversified Agriculture by County: 1960-1980

	Sugar[1]			Pineapple[2]			Diversified[3]		
	Value (000 $)	Acreage (number)	Employment (number)	Value (000 $)	Acreage (number)	Employment (number)	Value (000 $)	Acreage (number)	Employment (number)
Hawaii:									
1960	24,700	101,800	2,440	---	---	---	14,500	11,200	3,360
1970	41,000	107,500	1,900	---	---	---	24,700	16,000	3,980
1980	137,500	91,200	1,400	---	---	---	78,000	20,200	4,700
Kauai:									
1960	14,000	47,200	2,330	4,000	7,500	40	3,200	800	360
1970	22,700	50,3000	1,550	1,300	2,000	90	4,100	600	430
1980	83,600	46,000	1,400	---	---[4]	---	10,300	1,400	400
Maui:									
1960	15,500	42,300	2,050	20,300	44,300	2,4300	5,200	1,200	590
1970	26.600	45,700	1,450	25,700	41,500	2,240	6,600	1,300	1,130
1980	100,800	47,400	1,200	36,400	31,500	1,500	22,100	3,200	950
Honolulu:									
1960	13,000	33,300	1,420	11,800	22,800	1,290	23,700	2,600	2,480
1970	20,300	35,500	990	12,500	17,400	1,280	28,200	2,100	2,040
1980	63,200	33,100	800	40,200	11,500	1,000	61,500	3,300	1,700
State:[5]									
1960	67,200	224,600	8,240	36,100	74,600	4,160	46,600	15,800	6,790
1970	110,600	239,000	5,890	39,500	60,900	3,610	63,600	20,000	7,580
1980	385,100	217,700	4,800	76,600	43,000	2,500	171,900	29,300	7,750

1. Value of unprocessed cane; acreage in crop; field employment--does not include some self-employed and family workers who work on independent operations in Hawaii County only.
2. Value of fresh equivalent; acreage refers to land used for pineapple.
3. Diversified agriculture includes all crop and livestock except sugar and pineapple. Acreage data is for crops only and generally refers to area in crop; 1960 acreage figures exclude feed and forage crops and flowers and foliage; 1970 acreage figures exclude feed and forage crops. Diversified employment includes some self-employed and unpaid family workers on independent sugar operations in Hawaii County.
4. Less than 500 acres.
5. Acreage figures for Kauai, Maui, and Oahu are affected by the fact that macadamia nut acreages were aggregated and shown for one county or allocated to the state total to avoid disclosure; the 1980 county figures do not sum to state total for this reason.

Source: Statistics of Hawaiian Agriculture, 1969, 1972, 1973, and 1980 issues.

prices, was allowed to expire in 1974. Despite large cutbacks in pineapple acreage, rising prices and productivity enabled the value of production to increase between 1970 and 1980. For diversified agriculture, both livestock and crop production increased in value terms during the decade, reaching $171.9 million in 1980, about 27 percent of total agricultural output in Hawaii.

The importance of agriculture to the Counties of Hawaii, Kauai, and Maui--commonly referred to as the Neighbor Islands--is much greater than for the heavily urbanized City and County of Honolulu (Table 5). The sugar industry is especially important in the Neighbor Islands, where most of the employment and acreage is situated. The direct employment of both field and mill sugar workers was estimated to represent 9.4 percent of total Neighbor Island jobs in 1979 (DPED, April 1981). Pineapple production is now concentrated in Maui and Honolulu Counties; Kauai County no longer has any pineapple producers, nor does Hawaii County. With respect to diversified agriculture, Honolulu and Hawaii Counties have most of the activity as measured by production value and employment. Papaya, macadamia nuts, beef, and ornamental horticulture are some of the leading diversified industries on the island of Hawaii, while on Oahu the principal diversified activities are poultry, milk, eggs and swine. Compared with the Neighbor Islands, acreage increases on Oahu have been much less in the 1970-1980 period, and employment has declined. Diversified employment declined on Kauai and Maui also during this period, but in Hawaii County there was an 18 percent increase in employment.

Tables 6 and 7 provide a breakdown of the principal diversified activities. Among the crop industries, flowers and nursery products and macadamia nuts have experienced by far the largest growth (Table 6). Flowers and nursery products increased in sales from $4.2 million in 1970 to $27.4 million in 1980. In terms of acreage, the industry used about 800-900 acres in the 1970-1974 period, and increased more rapidly to 1,477 acres by 1980. As indicated in Table 6, out-of-state sales have consistently accounted for between 50 and 60 percent of all industry sales.

Macadamia nuts also exhibited large increases in sales, acreage and production. With 1980 sales of $24.2 million, macadamia nuts were just a little below flowers and nursery products. Most of this industry is located on the island of Hawaii, where acreage planted in orchard has increased greatly in response to favorable prices. Since macadamia trees do not begin to bear significant amounts of nuts before seven years, the acreage figures shown in Table 6 do

TABLE 6

Principal Crop Industries in Diversified Agriculture: 1970-1980

Industry	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Flowers and Nursery Products:											
Sales (000 $)[1]	4,225	4,484	5,101	6,674	8,211	9,767	11,828	14,003	17,458	20,778	27,441
Acreage[2]	807	743	757	777	877	996	1,128	1,210	1,203	1,312	1,477
Out-of-State Sales (%)	59	61	61	55	53	55	55	51	60	57	51
Macadamia Nuts:											
Sales (000 $)	2,868	3,475	3,157	3,092	5,238	5,754	7,007	8,029	11,287	16,769	24,174
Acreage[3]	8,735	9,170	9,250	10,450	9,890	10,400	10,250	9,895	10,200	11,400	13,400
Production (000 lbs.)[4]	13,216	14,070	14,165	12,124	16,370	18,210	18,990	19,680	20,980	26,600	33,390
Papayas:											
Sales (000 $)	2,436	2,736	3,423	4,180	4,871	5,668	6,134	7,565	8,304	9,510	9,979
Acreage[5]	1,040	970	985	1,430	1,690	1,840	1,930	2.155	2,190	2,210	1,950
Production (000 lbs.)[6]	24,960	20,725	25,735	32,824	37,224	39,896	50,037	63,548	64,000	41,015	48,916
Out-of-State Shipments (%)[7]	44	48	44	53	58	57	62	64	62	64	68
Coffee:[8]											
Sales (000 $)	1,449	1,135	1,104	1,711	714	1,399	3,922	3,133	2,117	3,137	2,175
Acreage[3]	3,900	3,400	3,000	2,900	2,900	2,400	2,400	2,400	2,300	2,100	1,900
Production (000 lbs.)[9]	4,300	3,280	3,200	3,040	1,540	1,860	2,120	2,270	1,680	2,190	1,450
Seed Corn:[8]											
Sales (000 $)	n.a.	n.a.	n.a.	1,156	2,032	1,905	2,185	1,389	1,740	2,100	2,280
Acreage[10]	1,835	480	510	440	1,250	503	600	460	480	510	570
Out-of-State Shipments (000 lbs.)	1,140	269	436	340	1,165	405	515	340	270	290	350
Tomatoes:											
Sales (000 $)	930	886	785	848	1,323	1,325	1,241	1,848	2,002	2,170	2,387
Acreage[5]	200	170	150	160	200	230	200	240	250	270	270
Production (000 lbs.)	5,500	4,300	3,300	4,000	4,900	4,800	4,700	6,000	7,000	6,200	7,700
Market Share (%)	56	43	32	37	43	43	40	48	47	42	49

n.a. = not available.

1. Wholesale value.
2. Acreage includes areas in open field, natural shade, under shade structures, and in greenhouses.
3. In crop.
4. Amount marketed (in shell).
5. Harvested.
6. Total amount utilized, including fresh and processed.
7. Percentage of total production shipped out-of-state as fresh papaya.
8. Data for crop years 1970-1971 through 1980-1981.
9. Marketings (parchment).
10. Acreage used for crop.

Source: Statistics of Hawaiian Agriculture, 1972, 1977 and 1980 issues.

TABLE 7

Principal Livestock Industries in Diversified Agriculture: 1970-1980

Industry	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Beef and Veal:											
Sales (000 $)	13,289	15,157	15,935	19,831	18,286	17,412	18,511	18,837	24,370	28,356	28,074
Production (000 lbs.)[1]	32,210	33,965	32,183	31,013	27,467	27,000	32,320	32,325	33,544	29,325	28,809
Market Share (%)	48	46	41	39	33	31	35	35	36	32	31
Milk:											
Sales (000 $)	12,960	13,226	14,494	16,472	19,387	20,549	21,943	23,158	23,715	24,894	27,071
Production (million lbs.)[2]	135.3	131.6	134,6	136.4	137.4	143.7	145.8	147.5	147.3	147.3	149.4
Eggs:											
Sales (000 $)	8,395	7,438	7,951	11,267	11,385	11,234	11,808	12,408	12,699	14,007	14,005
Production (million eggs)[2]	196	210	203	208	207	209	218	218	218	229	222
Market Share (%)	95	96	93	93	91	92	93	92	90	91	89
Broilers:											
Sales (000 $)	2,054	1,903	2,399	2,648	2,627	2,480	2,773	2,901	3.141	3,380	3,941
Production (000 lbs.)[3]	6,458	6,279	7.161	6,703	6,650	6,262	6,933	6,906	7,755	7,861	8,758
Market Share (%)	24	22	24	22	21	20	20	19	21	20	21
Hogs:											
Sales (000 $)	4,099	4,460	4,524	4,737	5,822	6,670	6,670	7,115	7,961	7,027	7,457
Production (000 lbs.)[3]	10,538	11,262	11,142	9,910	10,604	10,374	10,374	11,683	13,159	10,380	10,683
Market Share (%)[4]	31	31	30	26	27	25	25	29	32	24	23

1. Carcass weight equivalent
2. Amount Sold
3. Amount sold, live weight
4. Market share of Hawaii produced pork

Source: Statistics of Hawaiian Agriculture, the 1972, 1977 and 1980 annual issues, State Dept. of Agriculture.

not include orchards which have not yet begun to produce in commercial quantities. Thus, projected increases in the volume of production are relatively large.

Hawaii grows commercially a wide range of fruits and vegetables. In terms of sales volume, the other principal diversified crops are papaya, coffee, seed corn, tomatoes, taro, bananas, Chinese and head cabbage, cucumbers, ginger root, and head lettuce (all with 1980 sales volumes in excess of one million dollars).

The largest livestock industries are cattle and milk. The 1980 sales volumes were about the same, with beef and veal sales of $28.1 million and milk sales of $27.1 million (Table 7). Since 1970, the market share of Hawaii-produced beef and veal has gradually dropped from 48 percent to an estimated 31 percent in 1980. Mainland-grown beef and foreign imports supply the balance of Hawaii's market demand. With respect to eggs, Hawaii producers supply about 90 percent of total market demand, valued at $14 million in 1980. Although production has steadily increased between 1970 and 1980, market share slipped a little from about 95 percent in 1970-1971. Swine production, with 1980 sales of $7.5 million, is another significant livestock industry. However, since 1974, production has been at about 10.5 million pounds, with only a slight increase in sales volume. Chicken broilers are the remaining principal livestock industry, with production in the 6-8 million pound range throughout the 1970s, had a sales valume of $3.9 million in 1980, and supplied 21 percent of total market demand.

In contrast to sugar, pineapple, and some of the leading diversified crops, livestock production is virtually all for Hawaii consumption, although there are some live animal sales, primarily cattle, to mainland markets.

B. Potential of Hawaii Agricultural Industries

In this section the growth potential of sugar, pineapple and the various diversified agriculture industries is covered. It is not within the scope of this report to attempt independent forecasts of industry performance, rather the results of other studies and assessments will be discussed.

Establishing the potential of the various components of the agricultural sector is a critical element in the overall planning and priority setting process. Formulation of objectives, consideration of alternatives, and the design of programs, projects and actions depend on information on industry potential. The level of overall effort and specific goals of applied research and development (R & D) obviously relate to the likelihood and efficiency of achieving

overall society goals set for agriculture.

The University of Hawaii College of Tropical Agriculture and Human Resources (henceforth, CTAHR) conducts an ongoing agriculture Industry Analysis Program. As this program constitutes an important input or basis for agricultural planning and priority setting for R & D resource allocations, it is treated at some length in the larger study. However, for purposes of this report, the latest completed industry analyses provide the primary source for assessing the potential of the various commodity industries.

1. Sugar

In the previous section the significance of sugar historically and currently was reviewed. Given the fact that sugar utilizes about three-quarters of all land in crops in Hawaii, and that it generates a large number of jobs, especially in the Neighbor Islands, its continued viability is a matter of concern. One of the two principal State objectives in relation to agriculture is the "increased viability in sugar and pineapple industries" (DPED, 1978, p. 28).

During the three year period ending in December 1980, the average total acreage in sugar was 219,100 acres. To maintain economies of scale in both production and mill processing, it is important to keep acreage from steadily declining as it has during the 1970-1980 period. The latest sugar industry analysis completed by the CTAHR in May 1980 states:

> "Provided sound and rational Federal and State policies prevail, the sugar industry will continue its economic contributions by cultivating the current acreage and improving its yield per acre at an average rate of 1% per year."

The CTAHR industry analysis notes that sugar industry viability is directly affected by two factors: the failure of Congress to continue the Federal Sugar Act, and the competition of High Fructose Corn Syrup (HFCS) in the U.S. sweetener market. The analysis calls for a Federal nutritive sweetener policy which would provide for domestic industry protection against foreign sugar. The analysis points out that both policy and technological constraints affect the Hawaii sugar industry, but it is the policy constraints which are dominant, and these are largely beyond the control of the industry.

The First Hawaiian Bank in its analysis of the prospects for sugar, also completed in May, 1980, concluded that "...the sugar industry is expected to make a bigger contribution to the state's economy in the 1980s than it did in the 1970s." The First Hawaiian Bank prognosis was based on the U.S. ratification of the International Sugar Agreement (ISA) and the ability of Hawaiian

sugar companies to cut operating costs and generate revenue from the sale of electricity generated on the plantations. The ISA was judged to provide some beneficial degree of price stability for sugar, and the Public Utility Regulatory Policies Act of 1978 provided price incentives for plantation sales of electricity generated from bagasse and other sources of energy. It was also pointed out that the price of molasses had risen substantially because of its energy-related value for use in producing ethanol (First Hawaiian Bank, May 1980).

At the time of this writing, sugar prices paid to U.S. growers have fallen below 18 cents per pound. The average 1981 production cost for Hawaii producers has been estimated at 19.3 cents per pound by the Hawaiian Sugar Planters Association. Depressed sugar prices during most of 1981 are expected to result in aggregate industry losses of more than $80 million for 1981 (Honolulu Advertiser, January 18, 1982). Amfac, Inc., which operates five plantations, announced in January, 1982, that it would phase out the Puna Sugar Company on the island of Hawaii by 1984 because of heavy losses resulting from high costs of production together with the depressed level of sugar prices.

The new farm bill enacted by the Congress in December, 1981, is expected to provide some relief for Hawaii's sugar growers in the event that sugar price levels continue to be depressed by the relatively large amount of sugar being brought to the world market (the world market for sugar has traditionally been a "thin" market, accounting for only about one-sixth of world production, but in the absence of specific U.S. government market intervention measures, it is this market which determines the prices received by U.S. growers).

Under the new farm bill, a 17 cents a pound price floor is established beginning October, 1982, with a half-cent or less increase to occur in each subsequent year. Growers may borrow on their crop at 17 cents a pound and the government will take the crop as collateral. If the market price rises sufficiently high above the loan price, growers would sell their crops and pay off the loans plus interest. If market prices remain low, growers may default on their loans and let the government take the sugar held as collateral. However, under already existing legislation, the government may impose import fees and duties on foreign sugar, thus effectively raising the U.S. market price. If the government maintains the price of sugar above 17 cents a pound by the imposition of import fees and duties, the loan program may never become operable. Thus the future course of world market prices, and the extent to which the U.S. government supports the U.S. price by imposing import fees and duties, will have a large in-

fluence on whether the Hawaii sugar industry remains viable during the next few years. The farm bill provisions will minimize total losses when prices are low but if prices continue to remain at the newly established price floor, Hawaii sugar producers will be under heavy pressure to phase out a number of the other high cost plantations in addition to Puna Sugar Co.

In recognition of the possibility that some sugar plantations and/or smaller independent growers will go out of business, the DPED study included among its recommendations the continued effort to find replacement crops for sugar. This is viewed as desirable because of expected prolonged periods of limited profits and the consequent lower wages, taxes and other economic benefits that would accompany such conditions. To maintain economies of scale in sugar, the replacement crops should be limited in terms of acreage requirements. However, if significantly large cutbacks in sugar acreage were to be experienced, a number of replacement crops would be needed to absorb the large amount of released cropland. The research and development effort to find replacement crops for sugar is expected to be difficult and slow, given the large number of unsuccessful attempts with other crops in the last 150 years.

2. Pineapple

Along with sugar, pineapple is the other crop specifically targeted for increased viability in the State Plan. While not nearly as large in terms of acreage (43,000 acres in 1980), pineapple nevertheless makes a substantial contribution to the economy--$223 million in processed value in 1980.

The pineapple industry was analyzed by the CTAHR in June, 1979. Based on this analysis, the outlook is for production for the canned pineapple market to remain about the same level (about 610,000 tons annually), with possible modest increases in fresh pineapple (about 85,000 tons in 1977). To achieve this potential, a number of identified constraints need to be overcome. The highest priority was assigned to problems of crop pest and disease control; nematodes, mealybugs and heart and butt rot are difficult problems because of federal environmental controls on the use of certain chemicals, which have proven effective in the past.

Despite the steady down-trend in number of plantations (10 in 1955 to 3 today) and acreage used for pineapple, a recent DPED analysis and projection for pineapple was relatively optimistic (DPED, 1977). While average yield was expected to increase slightly from 16.2 in 1975 to 16.5 tons/acre/year by 1990, acreage was anticipated to rise from 42,100 acres to 47,300 acres over this

period. Acreage increases would occur primarily on Lanai and/or Molokai, while Maui island acreage would remain constant.

Factors considered favorable for pineapple in the DPED study were: a strong growth potential for fresh pineapple, technological innovations expected to boost yields and reduce costs, and increased mainland demand for canned pineapple together with reduced competition from foreign canners.

3. Diversified Industries

While sugar and pineapple acreage have gradually diminished and production has been approximately level since 1974, several of the diversified crops have expanded significantly in acreage and production since 1970. The diversified crops experiencing the strongest growth trends generally have been those serving the out-of-state markets. On the other hand, livestock industries which produce almost entirely for domestic consumption, have roughly kept pace with state population growth, except for beef, where production has leveled off since 1970.

Discussion of the growth potential for selected diversified commodity industries will be based on one or more of the following judgments: (1) promising new industry; (2) presently a strong growth industry; (3) currently an important industry, but one which has significant problems constraining further growth.

a. Macadamia Nuts

Introduced in Hawaii from Australia before the turn of the century, commercial production of macadamia nuts did not commence until the 1920s. In 1927, there were about 300 acres of orchard planted on Hawaii, Maui, Oahu and Kauai (Philipp, 1953). By 1970, the industry had grown substantially, with about 8,700 acres in crop, virtually all located on the island of Hawaii. In 1970, marketed production was 13.2 million pounds (in shell), with sales amounting to about $2.9 million (Table 6). An estimated 1.2 million pounds (processed) were shipped to the Mainland U.S. and foreign countries in that same year (DOA, June 1974).

By 1980, production increased sharply to about 33.4 million pounds, with a market value of $24.2 million, making macadamia nuts the single largest diversified crop industry. The industry in 1980 included some 465 farms with 13,400 acres in crop. Although commercial acreage has been planted on other islands, most acreage and production remains on the island of Hawaii. Most operations consist of small farms with approximately 85 percent of farms being less than 10 acres in size (Scott and Marutani, January, 1982).

The CTAHR completed its second Macadamia Nut Industry Analysis in March 1981 and projected a high growth potential of about 129 million pounds (marketed production, in shell) for 1990. The primary market is the U.S. mainland, but developed countries as in Western Europe are also expected to account for large market shares. Hawaii's present competitive position is considered strong, but a number of developing countries are starting macadamia nut industries and potentially could become significant competitors.

The major constraints to realizing full potential identified by the CTAHR are: (1) lack of information on potential markets (characteristics of consumer demand), products in which the processed nuts are used, and farm production costs; (2) lack of coordination between industry, state and federal officials in regard to potential market penetration by foreign producers. Hawaii producers oppose duty-free status for foreign producers; they are also concerned with federal policies and regulations which could significantly affect production costs and with the importation of planting materials which could bring in destructive crop pests; (3) lack of processing technology to increase kernel recovery rate, which is now about 23 percent. It is believed that a 35 percent recovery rate is possible, and if achieved, would increase profitability of the industry.

b. Papaya

Papaya has been grown commercially in Hawaii for a long time, but the introduction of the solo variety, with its superior taste, led to the development of an export industry. From about 320 acres in 1940, the size of the industry grew rapidly as indicated by the 1970 data in Table 6. About 1,040 acres were harvested in 1970, with utilized (for both fresh and processed markets) production amounting to about 25 million pounds and sales of $2.4 million.

From 1970 to 1977, production and acreage harvested increased greatly with 63.5 million pounds being produced on some 2,100 acres in 1977. During the 1977-1980 period, a number of problems including adverse weather, diseases and marketing disruptions affected the industry and resulted in production declines reflected in the 1979 and 1980 data (see Table 6).

Despite the recent problems, the long-term outlook for papaya is considered to be excellent, provided certain identified constraints are overcome. Between 1970 and 1978, papaya production increased at an annual average rate of about 12 percent. The CTAHR industry analysis of March 1979 projected potential growth at 8-10 percent per annum (CTAHR, March 1979).

The need for another means of treating export papayas for fruit flies has been underscored by recent events in the California market. In September, 1981, the California Occupational Safety and Health Administration (OSHA) Standards Board put new regulations into effect which require retailers to implement certain safeguards if their employees handle commodities which have been fumigated with ethylene dibromide (EDB). Even at low levels of residual EDB (less than 130 parts per billion), retailers must post signs in English and Spanish which warn employees of possible health risks, must provide training to employees who handle commodities, and must keep certain records.

As a result of the new regulations, most California retailers, including the large chains, will not accept papaya from Hawaii, even though the fruit shipped in surface containers has less than 15 ppb of residual EDB, a level considered extremely low. In view of the low level of EDB contamination, the Hawaii papaya industry is in the process of appealing the new California OSHA ruling, but thus far no waiver or exemption has been granted.

Since the California market represents about 50 percent of total Hawaii production, the industry's current sales volume is quite depressed. Of the alternative means of treating fruit flies, one method which combines hot water application, followed by refrigeration in shipping containers for a specified minimum period shows some promise. Even under the best of circumstances, it will take a long period of time before a new treatment method will be accepted by the U.S. quarantine authorities.

The major constraints faced by the industry were identified as the following: (1) the need for an economically acceptable fumigant for fruit flies, to replace ethylene dibromide, which is expected to be banned in the future by the Federal government; (2) inadequate transportation capacity and facilities for exporting fruit to the U.S. Mainland; and (3) post-harvest diseases, tree rot, powdery mildew, and papaya mosaic virus cause significant field losses and adversely affect quality of fruit before it reaches consumers. Since about 75 percent of papaya is exported, the above constraints, if not adequately addressed, would have an especially adverse impact on the industry.

c. Beef

The beef industry has been an important industry in Hawaii since before the turn of the century, and is presently the leading diversified sector in terms of sales ($28.1 million in 1980). However, beef production has remained level at about 30 million pounds (carcass weight equivalent) during the last

10 years. With an increasing state population, the percentage share of the Hawaii market supplied by the local industry has gradually declined from 51 percent in 1963 to 31 percent in 1980. Mainland suppliers account for about 58 percent of the local market demand, with the balance met by foreign imports.

Continued viability of the industry is important in that the 1.3 million acres of grazing land utilized is suitable for few alternative uses. Current outlook for the industry is for the maintenance of production of feedlot cattle at the current level, with a small increase in the production of range cattle (CTAHR, May 1981).

The cattle industry considers the following constraints to be the leading bottlenecks to growth and increased viability: (1) land and water availability at reasonable costs and terms; (2) lack of knowledge concerning the options available for increasing efficiency and returns through changes in slaughtering, processing, distribution and marketing; (3) insufficient information on alternatives for improving existing interisland transportation of cattle and beef, including consideration of outer-island feeding facilities; and (4) lack of knowledge on how to improve pasture so that better cattle nutrition and increased weight gains can be attained before animals are put in feedlots.

Competition from Mainland beef has captured a large part of the local market which formerly belonged to local producers. Continued resident and tourist population growth and the fact that only about 31 percent of current market demand is met by local production, means that a large potential exists for increasing local beef production. However, the immediate industry goal is to maintain or slightly increase production by overcoming to the extent possible, the constraints identified in the industry analysis.

d. Guava

Introduced into Hawaii in the early ninteenth century, the common guava soon thrived in the wild and was considered a pest. Not cultivated commercially until fairly recently, wild guavas have been gathered and processed for juice, jellies and jams. Of the 5.1 million pounds of fruit processed in 1970, only about 0.6 million pounds were from cultivated acreages (DPED, January 1981).

Guava is considered nutritious, being high in vitamins A, B, and C, and also containing calcium, phospherous, iron, thiamine, and niacin. It is used in a number of processed forms such as juice, nectar, sherbet and bakery products, and as such has had a favorable reception and good exposure to tourists. The CTAHR has developed superior varieties for commercial cultivation purposes,

but it was not until about 1971 that farmers became interested in growing the fruit commercially. Since 1970, growth in acreage and production has been rapid. In 1980, farm production amounted to 7.5 million pounds, harvested from 615 acres; another 360 acres were in crop but not harvested in 1980. Total processed output of guava in 1980 was nearly 10 million pounds, with cultivated guava representing about 76 percent of the total processed amount (DPED, January 1981).

Presently most of the processed guava is sold in the local market, thus the development of overseas markets will be necessary if significant industry expansion is to occur. Japan is thought to be a potentially strong foreign market; in 1979 0.8 million pounds were purchased by a single Japanese importer. The U.S. Mainland is anticipated to be the largest future market for Hawaii guava. Currently, Mainland sales are relatively modest, although it was estimated that California could take about 1.0 million pounds of puree as of 1979 (CTAHR, May 1979).

The DPED has estimated that almost 23 million pounds of guava will be harvested in Hawaii by 1983, based on acreage and production projections (DPED, January 1981). If realized, this would represent about a three-fold increase from the 1980 level of farm production. The CTAHR commodity analysis (May, 1979) indicates that a reasonable potential for the industry would be a 100 acre per annum increase in cultivation during the next five years.

Major constraints to achievement of growth potential were identified as follows: (1) lack of established overseas markets, including the U.S. Mainland; (2) the need for additional pesticides to be EPA-registered to fight periodic outbreaks of pests--presently only two pesticides are available; (3) inadequate facilities in Hilo for fruit storage and grading--currently available space is completely utilized, at times forcing growers to leave fruit in the field; (4) need for a method of aseptive processing and packaging to avoid excessive costs of shipping frozen puree to overseas markets.

e. Prawns

Aquaculture, defined as the propagation and cultivation of aquatic animals and plants for profit or social benefit, is probably Hawaii's youngest agriculture industry. While potentially encompassing a large variety of animal and plant species, currently prawns, oysters, catfish, and marine shrimp are the leading commodities in terms of commercial development. With a technological lead, prawn farming dominates the industry in terms of current production and sales. In 1980, an estimated 300,000 pounds of prawns were produced, with a

wholesale value of about $1.2 million. Twenty-four farm operations have a total of about 310 acres of ponds in production (DLNR, personal communication, August 1981).

Among the state's prawn farms, only one operation involves a relatively large acreage in ponds (100 acres); a second large producer is scheduled to begin commercial production in 1981. The industry is projecting an annual rate of growth of about 10 percent in production. Size of the potential market has not been determined, but evidence suggest that local market demand is quite price sensitive. The present market is primarily made up of Hawaii hotels and restaurants. Although size has not been estimated, the Mainland U.S. market is considered to be potentially large (CTAHR, July 1981).

The prawn industry views the following as the principal constraints to future growth: (1) State not being able to supply sufficient number of post-larval animals to stock private producers' farms; (2) the fact that under current policy, the state supplies these animals free, in direct competition with the private sector; (3) inadequate extension service for producers having pond management problems; need for increased staff of technically qualified and experienced extension specialists and facilities for water quality monitoring; (4) lack of adequate information and knowledge on prawn nutritional requirements; feed costs are high and the relative efficiency of various diets for prawns in different stages of growth has not been determined; (5) lack of knowledge concerning grow-out process for prawns; there is insufficient information on best means of achieving high productivity in raising prawns from the post-larvae stage; survival rates, the effects of stress and other variables on growth rates, and management practices which result in reduced production costs are subjects needing attention.

C. Development Issues

The future course of agricultural development in Hawaii will depend on many factors and influences, some of which will originate outside of Hawaii and thus be beyond the control of local decision makers. However, the manner in which Hawaii addresses its agricultural sector problems and opportunities, including the allocation of public resources to agricultural R & D will affect the ultimate outcome. This section takes up some of the broader issues confronting Hawaiian agriculture. The planning and resource allocation approach utilized in Hawaii is discussed in the fuller report.

1. Land

Agriculture is land extensive. Even the production of vegetables and culture of aquatic animals, considered to be relatively land intensive agricultural activities, requires a great deal of land in comparison with urban uses, such as shopping centers and light industrial plants.

The transition of Hawaii from an agriculture-based to a heavily service-oriented economy has been accompanied by rapid population growth. Population growth, especially on Oahu, has resulted in a competitive demand for land between agricultural and urban uses. Since the return on investment per acre of land in the more intensive urban use is much higher than for agricultural use, the inevitable result has been increased land prices and large withdrawals of land areas from agricultural uses. Agricultural lands located near existing urban centers or attractive shoreline areas are particularly sought by investors seeking the high return on capital typically afforded in an urban growth environment.

Moreover, large amounts of agricultural land, both nationally and in Hawaii, have been caught up in what has been referred to as the "impermanence syndrome." This is the situation where farmers in close proximity to expanding urban areas or developments perceive that agriculture in their area will not be permanent, and as a result, cease making long-term investments in their land and facilities. In areas affected by the impermanence syndrome, sales of land parcels are relatively frequent and many parcels are taken out of agricultural use and left idle (National Agricultural Lands Study, 1981).

In Hawaii, besides the pressure for conversion of prime agricultural lands to other uses, the other principal issues relate to land tenure, the agricultural use of lands taken out of pineapple and sugar, and the use of State land for agricultural purposes.

The State Board of Agriculture in 1977 adopted a system of land classification referred to as the ALISH system, "Agricultural Lands of Importance to the State of Hawaii." The ALISH system classifies lands according to their potential suitability for crop production, taking into account soil and other environmental characteristics. Of a total of about 4.035 million acres in the state, 0.978 million acres have been classified as important agricultural lands. These lands in turn are classified as prime, unique or other important lands. The best crop lands, prime and unique, together comprise 335,630 acres of the total state area. From Table 4, acreage in sugarcane in 1980 was estimated to be

217,700 acres, or about 65 percent of the state's best cropland.

Acreage in sugarcane has steadily declined in the last decade, and as noted above, one company has announced the phase-out of one of its operations. It is possible that other producers will close sugar operations, further diminishing acreage in cane cultivation. While the latest forecasts anticipate stability or modest gains in production, pineapple acreage declined 29 percent from 60,900 acres in 1970 to 43,000 acres in 1980.

Given the trends experienced since 1970, and the increased agricultural land prices generated by pressures to urbanize in many areas, perhaps one of the largest issues is that of government policy on lands taken out of sugar and pineapple. What, if any, agricultural uses can be expected to replace sugar and/or pineapple should acreage devoted to these crops continue to decline? What kind of land use controls are called for? Hawaii has a state land use law which was enacted in 1961 (Chapter 205, Hawaii Revised Statutes). Under this law, the State Land Use Commission and the counties have certain specified responsibilities for establishing and administering land use controls relative to lands contained in the agriculture and rural districts. [All land within the state falls into one of four districts: urban, rural, agriculture, or conservation. The Land Use Commission establishes and periodically adjusts the land use district boundaries.]

Along with high agricultural land prices, another significant issue is tenure. Many agricultural operators, particularly among the diversified industries, utilize leased land. Reflecting the general pattern of land ownership in Hawaii, agricultural lands in large part are owned by relatively few corporations, estates, or individuals. Some of these lands, in turn, are leased to diversified farm/ranch operators, many of which are smaller scale operations. As agricultural lands have appreciated because of the pressure to urbanize and the consequent speculation affecting parcels in many areas, owners have become increasingly reluctant to renew leases on terms (price and length of term) considered affordable by farm operators.

The agricultural land tenure issue has put pressure on the State government, a large landowner in its own right, to make more of its land available for agricultural uses on favorable terms. Some 350,000 acres of State land were under lease to private farm operators as of June 30, 1978, the bulk of which was being used as pasture land, but with about 67,600 acres in use for sugar cultivation (DOA, October 1980). At issue is the amount of State land and support going to diversified agricultural uses as opposed to large scale sugar and

pineapple growers. The present State program to construct agricultural parks with appropriate infrastructure, to be leased to diversified agricultural operators, could be considered a response to this issue.

2. Environmental Concerns

Industry analyses completed by the CTAHR and other agricultural studies have repeatedly cited the problems of farm operators dealing with environmentally related problems. Pollution controls, including regulated uses of pesticides, frequently affect farm productivity and costs. In some instances, federal regulations enacted primarily to address problems in other parts of the nation result in costs to Hawaii farm operators with little apparent benefits. An example is the federal requirement to clean waste-waters of mud before discharging into the ocean along the Hilo/Hamakua Coast, where turbulent conditions naturally prevail and compliance with the requirement produces little or no measurable benefit (DPED, April 1981).

The issue that constantly arises is the applicability or need for a nationally mandated control or abatement measure in light of the expected local benefits. In some instances, compliance would result in many farm operators shutting down because of excessive costs, and in a few cases entire industries could become non-viable because of mandatory controls.

3. Capital

Sources of loan capital for agricultural uses in Hawaii are quite diverse and include the following: commercial banks, Federal Land Bank, Hawaii Production Credit Association, Bank for Cooperatives, Farmers Home Administration, and several loan programs operated by the State Department of Agriculture. In certain instances, farmers may qualify for loans from the Small Business Administration, Hawaiian Homes Commission, and the Lokahi Pacific Community Development Company (DOA, September 1981).

As of 1978 about $172 million in loans to Hawaii farm operators were outstanding from the commercial banks ($20.5 million), farm credit banks ($120.0 million), Farmers Home Administration ($12.3 million), dealers (approximately $5.0 million), and the State ($14.3 million).

While the State has facilitated and supported the establishment of federal loan programs for farmers and of specialized private agricultural lending institutions in Hawaii, the accumulated amount of agricultural loans made directly by the State since 1959 has been quite modest, amounting to about $43.3 million.

In light of current state agricultural objectives toward developing diversified agriculture, and given the small scale and relative newness of many of the individual operators and commodity industries, the issue is whether there is enough capital available, and if not, by what means and from what sources should it come. Most of the industry analyses done under the auspices of the UH CTAHR have indicated that a shortage of capital was a constraint to development, especially for new industries such as the prawn and some parts of the flower and nursery products industries.

4. Water

The discovery of vast groundwater resources in 1879 enabled a greatly expanded agriculture in addition to an adequate supply of potable water for urban consumption. The underground aquifers, called Ghyben-Herzberg lens, are fed by rainwater percolating through the porous volcanic rock of the islands. The underground water lens have a maximum long-term sustainable yield dictated by average rainfall and surface area drained. Although surface waters make up part of the total available supply, groundwater is the primary source for Oahu. Excessive pumpage by water wells can result in contamination of the underground freshwater if it exceeds the rate of recharge over a sufficiently long period of time.

About 180,000 acres of cropland in Hawaii were irrigated as of 1978--almost two-thirds of the total acreage in crops. Sugarcane (122,000 acres) accounts for about two-thirds of the irrigated cropland acreage, and compared with other crops is a very large user of water.

In many areas of the state, and especially on Oahu, urban development and agriculture have begun to compete for available water resources. The Pearl Harbor basin, which supplies over half of Oahu's groundwater, has been designated a Groundwater Control Area. Limits have been placed on the amount of water which can be pumped, and the amount to be allocated among the principal user groups: the military, Board of Water Supply, Oahu Sugar Company, and private wells (First Hawaiian Bank, October 1980).

Additional water resources, both surface (reservoirs and ditch systems) and groundwater, can be developed, but capital costs will be quite large. A number of issues relate both to water resources development and to the management and claims on existing water resources. As between agriculture and non-agricultural uses, there is the question of relative priority, especially with respect to areas where lands are being shifted from agricultural to urban use. Preferential

rates for agricultural water users, and the respective shares of public resources, used to develop water intended for urban and agriculture uses are also unresolved issues.

Historically, the large plantations have provided for their own water systems. However, as water has become in short supply in many areas, disputes have arisen between public and private claims and among competing agricultural users. Since the existing system of water rights extends back to the customs and practices of the Hawaiian people, the legal basis and process for resolving competing claims is presently unsettled and time consuming.

Together with land, the availability and cost of water is one of the most frequently cited problems or bottlenecks identified in the industry analyses.

5. Transportation

Five main islands (Hawaii, Kauai, Maui, Molokai, and Oahu) account for most of the state's population--almost 80 percent live on Oahu; a sixth island, Lanai, is almost solely devoted to the production of pineapple by a single corporation. In terms of the commodity balance of trade with the Mainland and foreign countries, the incoming tonnage is twice the outgoing tonnage with most non-agricultural goods coming into the state via Honolulu Harbor (bulk fuel imports excluded). However, with respect to agricultural products, a large proportion of both export and domestically consumed commodities are grown in the Neighbor Islands and are shipped to Oahu for consumption or for transshipment overseas.

The above described circumstances create a difficult set of transportation problems for the farm operators of Hawaii. Incoming and outgoing cargo imbalances between Hawaii and overseas areas (primarily the Mainland U.S.). and between each of the Neighbor Islands and Oahu result in light payloads on the backhauls for commercial water and airborne (cargo) carriers.

Although a complicated problem, the issues may be stated in terms of defining the government's proper role in bringing about more adequate transportation service and/or lower costs for the various agricultural industries. It is recognized that Hawaii's transportation problems affect all sectors of the economy and not just the agricultural sector. To the extent that government resources are committed to providing transportation facilities or subsidies designed to lower costs, the question then becomes the priority or relative benefits which should be afforded agriculture, or given segments of agricultural industry.

6. Labor

Total employment in agriculture has steadily declined over a long period. In the large-scale corporate-operated sugar and pineapple plantations, productivity has advanced significantly, and while the workforce has declined, the remaining employees are among the highest paid farm workers in the world.

In 1980, there were about 7,350 sugar and pineapple field workers (excluding mill and cannery workers), and 7,750 persons working in diversified agriculture. Among the latter were 4,500 who were self-employed or unpaid family workers. While the self-employed and unpaid family worker category has remained at 4,500 since 1965, the number of hired workers in diversified agriculture has more than doubled over the recent 15-year period (see Table 3).

The large majority of farms in diversified agriculture are small in terms of number employed, many being operated with family labor with occasional seasonal hired workers. On an overall basis, employment in the agricultural sector is not anticipated to increase dramatically over the next ten years (DOA, September 1981). However, within certain of the diversified commodity industries, there have been shortages of workers, especially skilled employees. The industry analyses for a number of commodities have identified the lack of skilled and dependable workers as a growth constraint. In the industry view, the problem is typically that of finding workers of acceptable quality who will work at reasonable rates of pay.

The labor issue apparently stems from a general lack of interest on the part of the younger generation in pursuing careers in agriculture. Working conditions, salary levels, and growth and stability of employment appear to be perceived in a negative light by younger workers.

7. Government Support

The above discussed issues essentially involve government resources or intervention in some capacity. In certain instances, for example, controls on water and land uses, the appropriate role of the government may be quite controversial, depending on the particular problem being addressed. With respect to some of the basic agricultural policy objectives (or lack of explicit objectives), the issue is the degree of government support per se. Examples include the relative emphasis on supporting sugar and pineapple versus diversified industries, and relative benefits going to small versus large farm operators.

Policy objectives, well specified or not, are typically the focus of critics and proponents alike. The State Agriculture Plan which is covered in the

fuller report, addresses some of the issues involving government support. This section merely attempts to pinpoint the primary agricultural issues which have been discussed or debated in various segments of the community.

As Hawaii has become increasingly dependent on tourism, and energy costs and food prices have increased much more rapidly than the general price level since the early 1970s, the potential of Hawaiian agriculture needs to be re-examined. With respect to both food and energy, Hawaii is highly dependent on the outside world. Heavy dependence on outside suppliers for these requirements has given rise to the security issue of self-sufficiency. From a purely technical standpoint, Hawaii could produce sufficient food to feed its population, but the costs involved in becoming totally self-sufficient make this possibility highly unlikely. Yet, the degree, costs and types of self-sufficiency are still very much an issue.

The concept of self-sufficiency in food is of course interrelated with such issues as export versus import substitution (produced primarily for domestic consumption) commodities, food versus biomass for energy (and hence energy self-sufficiency), large corporate agribusiness versus small family operated farm operations, and increased viability of the sugar and pineapple industries versus greater emphasis on supporting selected diversified agricultural industries. Each of these issues has equity and growth considerations which are also germane and independent of the security issue.

Government support in the form of expenditures for research and development, tax subsidies, use of government land on preferential terms, market intervention via zoning and other controls on resource use and capital improvements are some of the means of influencing the extent to which the above alternative policy objectives may be realized.

To the extent that large government expenditures are required to obtain a given gain in self-sufficiency, less monies will be available to support the increased viability of sugar and pineapple, which are export industries. By the same token, the tradeoff between increased support of food self-sufficiency and increased energy self-sufficiency through use of biomass fuels, would mean a reduced level of support for one or the other.

The same kinds of tradeoffs or alternatives exist when addressing equity and growth (increased income and employment) considerations. Increased support of export industries (such as sugar, pineapple, papaya and macadamia nuts) may achieve the largest gains in total income, but may result in smaller gains in total agriculture employment, and a decrease in the share of income accruing to

small farm operators. Aside from the more advanced stages of agricultural development in Hawaii, the issues, alternatives and potential tradeoffs discussed in this section are not dissimilar to those confronting the Pacific islands and other areas seeking to accelerate their development.

It is clear that their resolution inevitably must be closely tied to the formulation and pursuit of specific agricultural objectives. The allocation of resources to agricultural sector programs and projects, likewise, should be consistent with well defined overall social and economic objectives if benefits or gains from these endeavors are to represent a satisfactory return on public expenditures.

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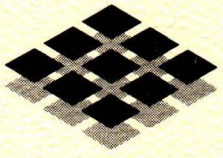

NOTE: As part of a structural reorganization, the Hawaii Agricultural Experiment Station and the Hawaii Cooperative Extension Service have been merged administratively under the name HAWAII INSTITUTE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES, College of Tropical Agriculture and Human Resources, University of Hawaii.

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College of Tropical Agriculture and Human Resources, University of Hawaii
Noel P. Kefford, Dean of the College and Director of the Institute
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